(2)

SULIT

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN MALAYSIA

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI JUN 2018

DJJ3103: STRENGTH OF MATERIAL

TARIKH : 08 NOVEMBER 2018
MASA : 11.15 PAGI - 1.15 TENGAHARI (2 JAM)

Kertas ini mengandungi **DUA BELAS (12)** halaman bercetak.
Struktur (4 soalan)
Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:
This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1
C1

(a) Define the terms as below and state its unit.
Definasikan istilah-istilah berikut dan nyatakan unitnya.

i. Stress
Tegasan

[2 marks]
[2 markah]

ii. Strain
Terikan

[2 marks]
[2 markah]

iii. Safety factor
Faktor keselamatan.

[2 marks]
[2 markah]

CLO1
C2

(b) A copper wire 4 m long was act by 100 kN of tensile load. If the stress applied is 60 MN/m^2 and given E_{copper} = 112 GN/m^2, calculate:

Satu dawai kuprum panjang 4 m, dikenakan beban tegangan 100 kN. Jika tegasan yang berlaku di dalam kuprum ini adalah 60 MN/m^2 dan diberi nilai E_{kuprum} = 112 GN/m^2, kirakan:

i. The strain in the copper
Keterikan yang berlaku di dalam kuprum.

[2 marks]
[2 markah]

ii. The elongation of copper.
Pemanjangan yang berlaku pada kuprum

[2 marks]
[2 markah]

iii. The diameter of copper.
Diameter bagi kuprum

[4 marks]
[4 markah]

CLO1
C3

(c) A series of bar consists of copper and aluminium bar which is fixed in between two rigid walls as **Figure 1(c)**. Determine the thermal stress induced in each bar if the temperature is increased by 80°C. Given that $E_{aluminium}$ = 69 GNm/^{2} and E_{copper} = 112GN/m^2. $\alpha_{aluminium}$= 23 x 10^{-6} /°C , α_{copper} = 17 x 10^{-6} /°C.

Satu bar sesiri yang terdiri daripada kuprum dan aluminium dipasang tegar antara dua dinding seperti dalam ***Rajah 1(c)****. Tentukan tegasan haba di dalam setiap bar tersebut jika suhu meningkat sebanyak 80°C. Diberi nilai* $E_{aluminium}$ *= 69 GN/m^2 dan* E_{kuprum} *= 112 GN/m^2.* $\alpha_{aluminium}$ *= 23 x 10^{-6} /°C ,* α_{kuprum} *= 17 x 10^{-6} /°C.*

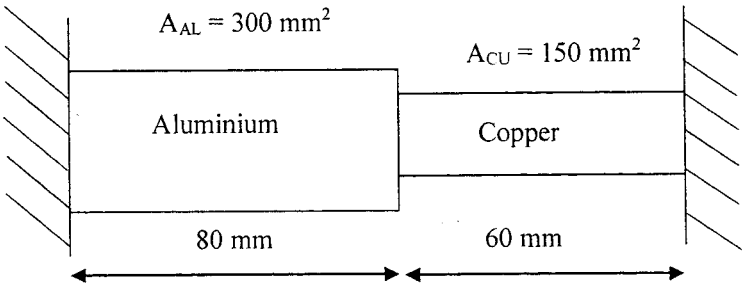


Figure 1(c)/ Rajah 1(c)

[11 marks]
[11 markah]

QUESTION 2

SOALAN 2

A simply support beam is shown in **Figure 2**.

*Satu rasuk disokong mudah ditunjukkan seperti **Rajah 2**.*

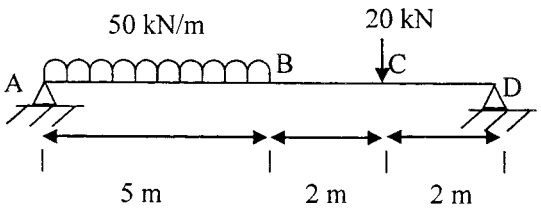


Figure 2/Rajah 2

CLO1
C2

(a) Determine the reaction force on both supports.

Tentukan daya tindak balas di kedua hujung yang disokong.

[5 marks]

[5 markah]

CLO1
C3

(b) Determine the shear force and draw the shear force diagram of the beam.

Tentukan daya ricih dan lakarkan gambarajah daya ricih bagi rasuk tersebut.

[10 marks]

[10 markah]

CLO1
C3

(c) Determine bending moment and draw the bending moment diagram of the beam.

Tentukan momen lentur dan lakarkan gambarajah momen lentur bagi rasuk tersebut.

[10 marks]

[10 markah]

QUESTION 3

SOALAN 3

CLO1
C1

(a) State the name of each quantity and its unit for the bending stress formula below.
Nyatakan nama dan unit bagi setiap kuantiti bagi rumus tegasan lentur di bawah.

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

[6 marks]
[6 markah]

CLO1
C2

(b) A cantilever beam with L cross section is loaded with 3 kNm as moment at the edge as shown **Figure 3(b)** above. Given E = 165 GN/m^2 and determine:

*Sebatang rasuk julur yang berkeratan rentas L dikenakan momen 3 kNm dihujung rasuk seperti **Rajah 3(b)** di atas. Diberikan E = 165* GN/m^2, *tentukan:*

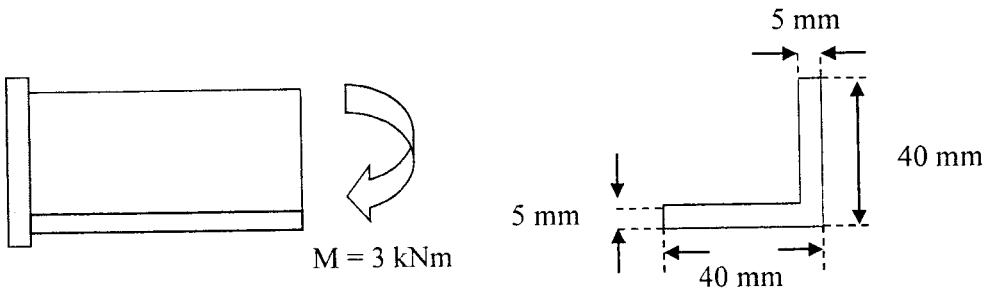


Figure 3(b)/Rajah 3(b)

i. Neutral axis
Paksi neutral

[3 marks]
[3 markah]

ii. Second area of moment
Momen luas kedua

[3 marks]
[3 markah]

iii. Maximum bending stress.
Tegasan lentur maksimum.

[2 marks]
[2 markah]

CLO1
C3

(c) A simply support beam shown in **Figure 3(c)** is loaded with Uniformly Distributed Load. Based on the figure, calculate the slope and deflection at position 3 m from point A by using Double Integration Method.

*Satu rasuk disokong mudah seperti **Rajah 3(c)** di atas dikenakan dengan daya teragih seragam. Berdasarkan rajah tersebut, tentukan kecerunan dan pesongan rasuk pada kedudukan 3 m dari titik A dengan menggunakan Kaedah Kamiran Berganda.*

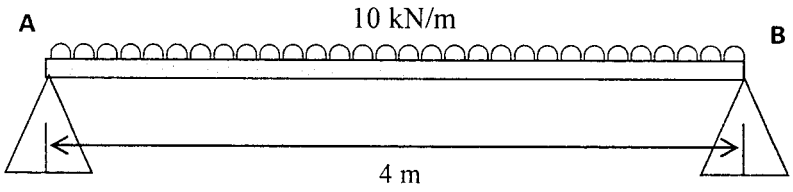


Figure 3(c)/ Rajah 3(c)

[11 marks]
[11 markah]

QUESTION 4

SOALAN 4

CLO1
C1

(a) For the torsional equation, state the units for each quantity:

Bagi persamaan kilasan aci di bawah, nyatakan unit bagi setiap kuantiti dalam persamaan tersebut.

$$\frac{T}{J} = \frac{G\theta}{L}$$

[5 marks]

[5 markah]

CLO1
C2

(b) A shaft with 50 mm diameter and 0.7 m long is subjected to torque of 1200 Nm. Calculate the shear stress and the angle of twist. Given G = 90 GPa.

Satu aci berdiameter 50 mm dan panjangnya 0.7 m dikenakan dengan daya kilas sebanyak 1200 Nm. Kitakan tegasan ricih dan sudut kilas yang berlaku. Diberikan G = 90 GPa.

[7 marks]

[7 markah]

CLO1
C3

(c) A shaft with a diameter of 300 mm and length of 2 m transmits 250 kW power at 120 r.p.m. If the modulus of rigidity of the shaft is 100 GN/m^2, calculate:

Satu aci yang berdiameter 300 mm dan panjang 2 m menghasilkan 250 kW kuasa pada 120 p.p.m. Jika modulus ketegaran aci adalah 100 GN/m^2, kirakan:

i. The maximum shear stress in the shaft.
Tegasan ricih maksimum di dalam aci

[7 marks]
[7 markah]

ii. Angle of twist, in radian.
Sudut kilasan dalam unit radian

[3 marks]
[3 markah]

iii. Shear stress at a radial distance of r = 100 mm.
Tegasan ricih pada jejari aci, r = 100 mm.

[3 marks]
[3 markah]

SOALAN TAMAT

LIST OF FORMULA DJJ3103- STRENGTH OF MATERIALS

FORCES ON MATERIALS

1. Safety factor = $\dfrac{\text{Maximum Stress}}{\text{Work Stress}}$

2. Poisson's Ratio, $\nu = \dfrac{\text{laterial strain}}{\text{longitudinal strain}}$

3. Percent Elongation = $\dfrac{\text{Elongation}}{\text{Length}}$ x 100 %

4. Percent reduction in area = $\dfrac{A_f - A_o}{A_o}$ x 100 %

5. Strain Energy, $U = \dfrac{1}{2} P\Delta L$

THERMAL STRESSES AND COMPOSITE BARS

1. Equation of a parallel composite bar subjected to a temperature change.

$$\frac{\sigma_1}{E_1} + \frac{\sigma_2}{E_2} = (\alpha_2 - \alpha_1)\,\Delta t$$

2. Equation of a series composite bar subjected to a temperature change.

$$\frac{P_1 L_1}{A_1 E_1} + \frac{P_2 L_2}{A_2 E_2} = \Delta t(\alpha_1 L_1 + \alpha_2 L_2)$$

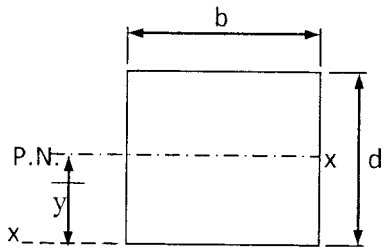
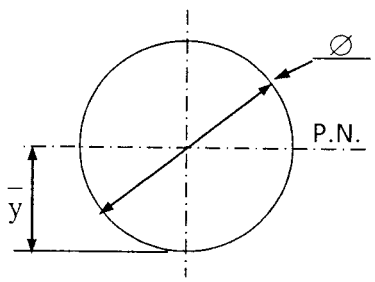
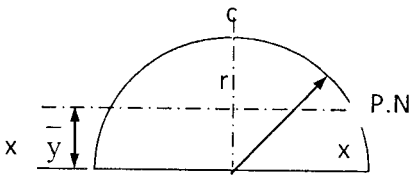
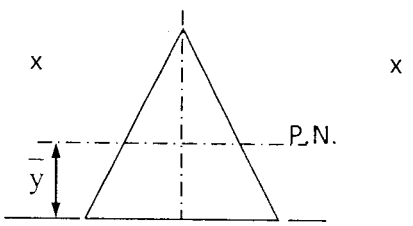
SHEAR FORCES AND BENDING MOMENT

$$\sum M_A \circlearrowleft = \sum M_A \circlearrowright$$

$$\sum F \uparrow = \sum F \downarrow$$

BENDING STRESS

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

SHAPE	CENTROID	MOMENT OF INERTIA
	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_{P.N.} = \frac{bd^3}{12}$ $I_{xx} = \frac{bd^3}{3}$
	$\bar{x} = d/2$ $\bar{y} = d/2$	$I_{P.N.} = \frac{\pi d^4}{64} = \frac{\pi r^4}{4}$
	$\bar{y} = \frac{4r}{3\pi}$	$I_{P.N} = 0.11\,r^4$ $I_{xx} = \frac{\pi r^4}{8}$
	$\bar{y} = h/3$	$I_{P.N.} = \frac{bh^3}{36}$ $I_{xx} = \frac{bh^3}{12}$ $I_{xy} = \frac{hb^3}{48}$

TORSION OF SHAFT

1. TORSION FORMULA

$$\frac{T}{J}=\frac{\tau}{R}=\frac{G\theta}{L}$$

2. POLAR MOMENT OF INERTIA

$$J=\frac{\pi d^4}{32}$$

3. SERIES COMPOSITE SHAFT

$$T=\frac{G_1\theta J_1}{L_1}=\frac{G_2\theta_2 J_2}{L_2}$$

$$\begin{aligned}\theta_{AC} &= \theta_{AB}+\theta_{BC}\\ &= \frac{T_1L_1}{G_1J_1}+\frac{T_2L_2}{G_2J_2}\\ &= T\left(\frac{L_1}{G_1J_1}+\frac{L_2}{G_2J_2}\right)\end{aligned}$$

4. PARALLEL COMPOSITE SHAFT

$$T = T_1 + T_2$$

$$\theta = \left(\frac{T_1L_1}{G_1J_1}\right)=\left(\frac{T_2L_2}{G_2J_2}\right)$$